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QFD in Malaysian SMEs Food Packaging CAD (PackCAD) Testing

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Abstract

Nowadays, most of the Small & Medium Enterprises (SMEs) entrepreneurs improves the effectiveness of product markets through the strategic implications of using a Computer Aided Design system (CAD) in an attractive packaging design. Therefore, a CAD Packaging-Computer Aided Design (PackCAD) prototype system was developed to support the design process of food products packaging. Modules developed provide user convenience to choose the pull-place (drag-drop) packaging form prepared in template (stored in the data library). Quality function development (QFD) method is used in both phase; the identifying user requirements phase and the verification and validation phase. Food packaging design files from CATIA V5R18 and AutoCAD2012 is used to perform verification and validation. This paper focus on produce House of Quality QFD diagrams related to the geometry data exchange from design files that have been constructed using PackCAD is readable and can be opened in other CAD software. SME entrepreneurs are able to design product packagings that were being produced by using PackCAD system with minimal skills in computer handling.

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Keywords: Computer Aided Design; Quality Function Deployment; food packaging; Malaysia SMEs

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1. Introduction

Quality Function Deployment (QFD) was first introduced in Japan by Yoji Akao in 1966 [1-3]. QFD is a method that can help the organization to identify the clients' needs to be translated into various forms of strategy and planning company that would be able to contribute to the continuous improvement of a given service or product produced.

2. Literature review

2.1. QFD implementation

QFD allows the design phase to focus on key customer requirements, the elements defined as very important to the customer. Shortened the design phase to focus on items that customers really want to deal with these elements. Our focus, the less time will be spent to redesign and renovation. Provident has now estimated as one-third to half of the time taken using traditional means. If the new product takes eighteen months from concept to market, using QFD it can reduce the time for 9-12 months, with little if any change to the product once it is on the market [4]. QFD method has proven to be very effective in mapping the needs of both internal and external to the product features contained in a particular architecture. Methodology best suited to express the concept of a very specific product at a specific point. Quality two-dimensional house is not suitable for the need of products, product features, and the all in one chart. In applying the QFD process it is necessary to create two different levels QFD chart, one of the product features are mapped to product requirements and other characteristics that are mapped to the current product [5].

QFD is used for outsourcing software development based on the analysis of issues of offshore software development outsourcing and existing methods of Software Quality Assurance (SQA). In addition, customer satisfaction oriented model for Outsourcing Software Quality Management (OSQMM) is proposed in this paper. OSQMM stand out by focusing on analyzing and interpreting "Voice of the Customer". This model proved to be effective through a case study on the development of accounting information systems [6]. Product design and manufacturing systems to produce it is a process that is strongly influenced by the organizational structure and culture that supports [2]. QFD is a quality-oriented process can play an important role in market-driven environment of total quality control. It can be used in almost any area or product development, testing and manufacturing processes. QFD is one way to ensure the reliability of software products[7].

Fig. 1. shows the use of House of Quality (HOQ) matrix QFD [1, 8] to evaluate the needs of users in the development and testing phase PackCAD. QFD to determine the needs of the end user, a special component identified. In the concept development phase, the designers want to quickly create a "whole design and user interface to make simple sketches, known as" product thumbnail sketch ", to evaluate ideas and possibilities [8]. PackCAD propose a suitable template in the form of frozen food products such as form a semicircle to curry puffs, donuts and circle to form a triangle for samosa. The user must enter a value such as dimensions for the selected shape PackCAD suggest types of packaging design. House of Quality aims to determine the quality of customer needs, determine the relationship between customer needs with technical requirements, assess technical requirements and determine the value of products targeted for the technical requirements of the product [9]. HOQ illustrating a house where it is divided into the main part of the roof and walls. HOQ roof interact with the design in which it lists the technical requirements. HOQ wall also lists the user needs [10]. Here are the steps that need to be implemented to implement QFD:

a. List the needs of customers or users
b. List the technical design elements
c. Build the relationship between customer needs with technical design elements
d. Identify the correlation between design elements for HOQ roof.
e. Perform competitive assessment to the needs of customers or users
f. Make a list of priorities (target) user requirements
g. Make a list of priorities (target) needs are technical
h. final assessment

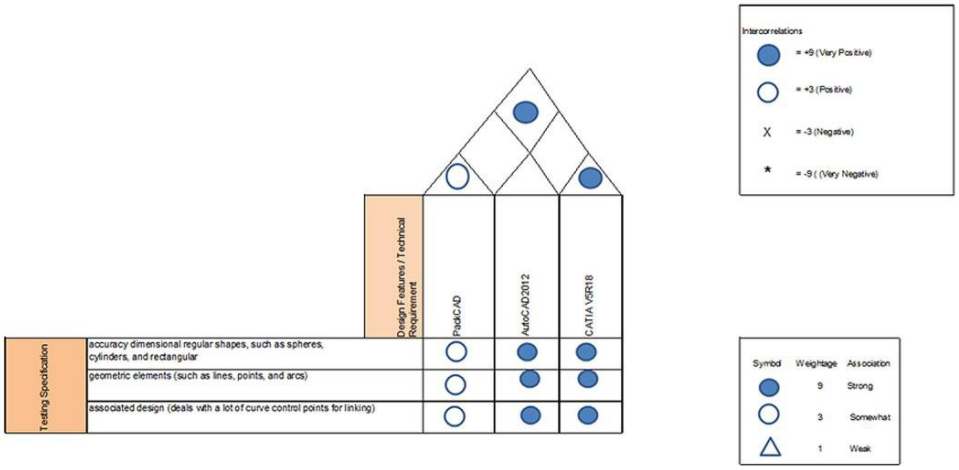

Fig. 1. House of quality (HOQ) QFD matrix.

2.2. QFD in food industry

QFD has been used in the food industry since 1987 [1]. Potential use of QFD for the development of food products to increase the chances of success, producing high quality products, reduce costs and development time. However, a detailed assessment on the use of QFD for product development food QFD revealed that some examples used in the actual development or enhancement of food products is limited. However, QFD has been proved beneficial if adjustments to the rules made and the specific characteristics of food taken into account [11]. The study was carried out in the use of QFD brown food industry [12]. The purpose of this study was to develop a structured approach to the development of food through HOQ model. Research procedure consists of the steps that have been identified. First, market research has been conducted to determine consumer segments Secondly, the behavior of the users in the target motif analysis. Then the specifications of the product have been developed through the physico-chemical and instrumental methods. Finally, sensory analysis was performed involving both consumers and trained panel. Some correlation between instrumental and sensory scores were developed. The final step of the research related to the analysis of the mutual relationship between technical measures and sensory and integration results in the HOQ.

QFD is a technique of product development to translate customer requirements for product development activities and services [13]. The study was carried out by researchers using QFD to identify the needs of American consumers for bulgogi (Korean dish that is popular among international customers) and how to meet their needs. A customer surveys and expert opinion survey was conducted for U.S. customers. Eighteen engineering features have been developed. The relative importance of engineering characteristics, correlations, and technical complexity of the position and integrated to develop the most effective strategy. These findings were discussed relative to implications for the industry.

2.3. QFD in software testing

QFD is a quality-oriented process can play an important role in the market driven by the environment, total quality control. It can be used in almost all areas of development, testing and product manufacturing processes. QFD is one way to ensure the reliability of software products [10].

3. QFD testing

3.1. Data exchange technique testing

3.1.1 Testing and comparison with manual methods

User testing is manual testing software for defects. It requires a tester to play the role of the end user, and use most of the features of the application to ensure correct behavior. To ensure completeness of testing, testers often follows a written test plan that leads them through a set of important test cases. Measures implemented manually testing is unit testing and system testing.

i. Unit Testing

Unit testing to detect errors in the component or software module. Based on the component design documents, important control paths are tested to detect errors in the scope of the module. The focus is a logical unit testing internal processes and data structures. Unit testing for some of the components can be executed in parallel.

Test cases should be designed to detect errors caused by processing or comparative claims, or improper control flow. Among the most frequent errors in processing are:

a. priorities wrong or unclear in an arithmetic expression
b. mixed modes of operation,
c. initial value of one,
d. accuracy of one, and
e. representation of the expression symbols.
f. Comparison and flow control are closely related, where the exchange flow usually occurs after comparison. Test cases should be able to detect errors such as:
g. comparison of different data types
h. processing logic or the wrong priorities
i. make the comparison equation when it is impossible
j. comparison of variables that one
k. one end of the loop or does not exist
l. failed to run out when the repetition of the route should be
m. modified loop variable one

Software often fails at the border, especially if it involves a loop. Test cases should test the data structures, flow control, and data values before, during, and after the minimum and maximum boundaries to detect errors. Software often fails at the border, especially if it involves a loop. Test cases should test the data structures, flow control, and data values before, during, and after the minimum and maximum boundaries to detect errors. Good design should anticipate the errors and provide error handling to handle the event. Among the mistakes that need to be tested to assess the error-handling routine:

a. evidence of error cannot be understood
b. error is not the same set of errors found
c. conditions cause system failure before the intervention enabled error handling routine
d. handling exception conditions are not right
e. evidence is not error to give enough information to detect the cause of the errors

The design of unit testing can be done before or after the code generation. Test cases should be prepared in accordance with the design review so that errors in each category that have been discussed can be detected. Each test case should be attached with the expected output. Components are part of the software, and cannot be implemented on its own. By the drivers and stubs must be provided for each test unit. Driver is a program that receives data from test cases, sending data to the component being tested, and related print output. Stub will replace all other modules

that are called by the component. Stub is a replacement module using interface module predecessor, print confirmation call, may make data processing and the next minimum return control to the component being tested.

ii. System testing

Developers are the most qualified and responsible to perform component testing. In most cases, he is also involved in integration testing that integrates entire software architecture. Usually an independent testing will be involved in the testing of the completed system. The role of an independent testing is to perform the test without any interest, and thus solve the problem of conflict between the interests of developers. During independent testers execute testing, developers have to prepare and work to correct the detected errors. An independent testing group is part of the development group for involvement in the project specifications, plans and specification testing procedures in a large project. However, in most cases, these groups are part of the quality assurance [12, 13].

3.1.2. Testing and comparison with other CAD systems

Sketches and design parameters associated identified [14] to test the system and RBK PackCAD other involved the CATIA V5R18 and AutoCAD2012. For common forms such as circles or lines, the parameters used to link the relative dimensions while for irregular shapes such as curves and surfaces, the associated design is used to do work in gathering merit equally applicable to other engine designs, reduce design time and errors the design

4. Result & discussion

Findings of studies are discussed generation QFD house of quality results in the phase questionnaire to identify user requirements using QFD and testing phase and comparison with other CAD systems using the QFD. Seven respondents identified consisting of experts and practitioners of CAD in the industrial sector. They were given a sample of the food packaging design and implement standards-compliant testing according to the parameters that have been identified within three (3) of CAD software (PackCAD, CATIA V5R18 and AutoCAD2012). Fig. 2. shows the House of Quality QFD testing and comparison with other CAD system. The parameters involved in the test are:

a. Accuracy dimensional regular shapes, such as spheres, cylinders, and rectangular
b. geometric elements (such as lines, points, and arcs)
c. associated design (deals with a lot of curve control points for linking)

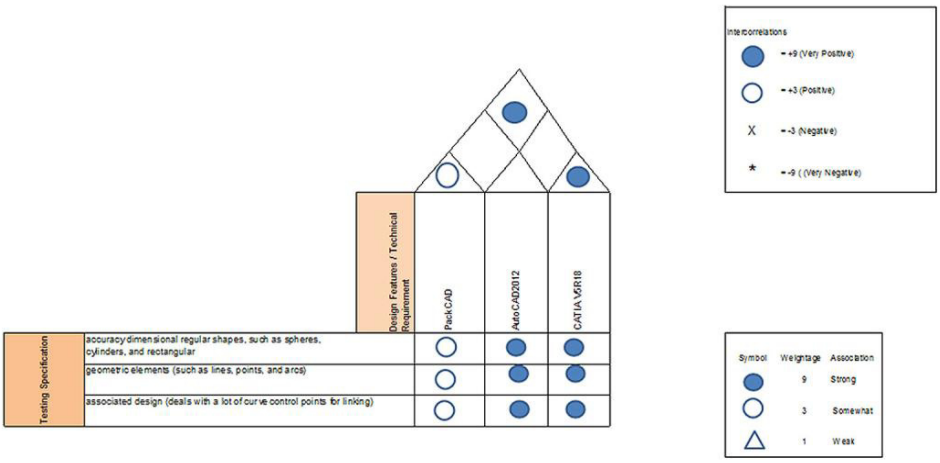

Fig. 2. House of quality QFD quality testing and comparison with other CAD system.

Fig. 3. shows the test results are illustrated in the form of QFD house of quality for a prototype system. The average scale of interest for the system prototype was “3” of scale PackCAD respondents put PackCAD prototype system testing status is "Good".

Testing Specification (PackCAD)	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6	Respondent 7	Average Interest Scale
accuracy dimensional regular shapes, such as spheres, cylinders, and rectangular	3	4	4	3	2	3	4	3
geometric elements (such as lines, points, and arcs)	3	4	4	3	2	3	4	3
associated design (deals with a lot of curve control points for linking)	2	4	4	3	2	3	3	3

Fig. 3. House of quality QFD the test results for the pack CAD prototype system.

Fig 4 and Fig 5 shows the QFD house of quality the test results for other CAD system (CATIA V5R18 and AutoCAD2012). The average scale of interest is the same “4”. Respondent decided that other CAD system CATIA V5R18 testing and AutoCAD2012 is "Very Good".

Testing Specification (CATIA V5R18)	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6	Respondent 7	Average Interest Scale
accuracy dimensional regular shapes, such as spheres, cylinders, and rectangular	4	3	4	3	5	4	5	4
geometric elements (such as lines, points, and arcs)	5	3	5	4	5	5	5	5
associated design (deals with a lot of curve control points for linking)	5	3	5	3	4	4	4	4

Fig. 4. House of quality QFD the test results for CATIA V5R18.

Testing Specification (AutoCAD2012)	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6	Respondent 7	Average Interest Scale
accuracy dimensional regular shapes, such as spheres, cylinders, and rectangular	5	4	3	4	3	5	4	4
geometric elements (such as lines, points, and arcs)	5	4	4	4	3	5	4	4
associated design (deals with a lot of curve control points for linking)	4	3	4	4	3	5	4	4

Fig. 5. House of quality QFD the test results for the AutoCAD 2012.

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References

[1] A.I.A. Costa, et al., “Quality function deployment in the food industry: a review,” Trends in Food Science & Technology, vol. 11, no. 9â€“10, 2000, pp. 306-314.
[2] J.J. Cristiano, et al., “Key factors in the successful application of quality function deployment (QFD),” Engineering Management, IEEE Transactions on, vol. 48, no. 1, 2001, pp. 81-95.
[3] G.H. Manzur, “QFD in the Food Processing Industry,” 2008.
[4] J.L. Bossert, “Quality Function Deployment: A Practitioner's Approach,” Book Quality Function Deployment: A Practitioner's Approach, Series Quality Function Deployment: A Practitioner's Approach, ed., Editor ed.^eds., ASQC Quality Press, 1991, pp.
[5] M.S. Leonard and J.B. Bowles, “The application of QFD to computer-system architecture,” Proc. Reliability and Maintainability Symposium, Proceedings., Annual, 1994, pp. 359-365.
[6] X. Wei, et al., “Study of a Customer Satisfaction-Oriented Model for Outsourcing Software Quality Management Using Quality Function Deployment (QFD),” Proc. Wireless Communications, Networking and Mobile Computing. WiCOM '08. 4th International Conference on, 2008, pp. 1-5.
[7] X.F. Liu, “Software quality function deployment,” Potentials, IEEE, vol. 19, no. 5, 2000, pp. 14-16.
[8] S.-U. Cheon, et al., “A procedural method to exchange editable 3D data from a free-hand 2D sketch modeling system into 3D mechanical CAD systems,” Computer-Aided Design, vol. 44, no. 2, 2012, pp. 123-131.
[9] J.M. Rohani and S. Tamat, “Peningkatan Kualiti Reka Bentuk Kerusi Sekolah Rendah dengan Mengintegrasikan Kaedah QFD dan Kejuruteraan Nilai ” Jurnal Teknologi, vol. 35(A) no. Dis. 2001, 2001, pp. 35–46.
[10] S.T. Foster, Managing Quality: Integrating the Supply Chain, Pearson Education, Inc, 2007.
[11] M. Benner, et al., “Quality Function Deployment (QFD)â€”can it be used to develop food products?,” Food Quality and Preference, vol. 14, no. 4, 2003, p. 327-339.
[12] U. Faculty of Computer Science and Information Systems, “Strategi Pengujian,”; http://se.cs.utm.my/notes/nota-kejuruteraan-perisian/13-Objek.htm#Pengujian2. 2011.
[13] Anon., “Strategi Pengujian,”; http://se.cs.utm.my/notes/nota-kejuruteraan-perisian/13-Objek.htm#Pengujian2. 2011.
[14] S.M.a.C.-S.T. Song-Hao Wang, “Application of Parametric Sketching and Associability in 3D CAD,” Computer-Aided Design and Applications, vol. 5(6), pp. 822-830; DOI 10.3722/cadaps.2008.822-830.